



W91321-04-C-0023

LOGANEnergy Corp.

U.S. Army Engineer Research and Development Center,
Construction Engineering Research Laboratory PEM Demonstration Project
Initial Project Report

Proton Exchange Membrane (PEM) Fuel Cell Demonstration
Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY03

Camp Mabry ANGB, Austin, TX

November 10, 2004

Executive Summary

Under terms of its FY'03 DOD PEM Demonstration Contract with ERDC/CERL, LOGANEnergy in cooperation with Austin Energy will install and operate a Plug Power GenSys 5kWe Combined Heat and Power fuel cell power plant (see Appendix section 2) at Camp Mabry Army National Guard Base, Austin, TX. The site on the base selected for the one-year demonstration project is the Texas National Guard Museum. The unit will be electrically configured to provide grid parallel service to the site and it will also be thermally integrated with a small desiccant HVAC unit to provide seasonally warm or cool dry air to benefit moisture sensitive displays in the museum. Local electrical and mechanical contractors may be hired to provide services as needed to support the installation tasks. It is anticipated that the project will add \$26.20 annual energy costs to Camp Mabry during the period of performance.

The Camp Mabry ANGB POC for this project is Dennis Feary who may be reached at 512.782.6071, Denis.Feary@tx.ngb.army.mil.

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Proposal – Proton Exchange Membrane (PEM) Fuel Cell Demonstration of Domestically Produced Residential PEM Fuel Cells in Military Facilities

1.0 Descriptive Title

LOGANEnergy Corp. Small Scale PEM 2004 Demonstration Project at Camp Mabry ANGB, Austin, TX

2.0 Name, Address and Related Company Information

LOGANEnergy Corporation

1080 Holcomb Bridge Road
BLDG 100- 175
Roswell, GA 30076
(770) 650- 6388

DUNS 01-562-6211
CAGE Code 09QC3
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 PAFC and PEM fuel cell projects at 21 locations in 12 states, and has agreements to install 22 new projects in the US and the UK over the next 18 months.

3.0 Production Capability of the Manufacturer

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP Gas unit, and the GenCor 5kW standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Scott Wilshire is the Plug Power point of contact for this project. His phone number is 518.782.7700 ex1338, and his email address is scott_wilshire@plugpower.com.

4.0 Principal Investigator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

5.0 Authorized Negotiator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

6.0 Past Relevant Performance Information

a) Contract: PC25 Fuel Cell Service and Maintenance Contract #X1237022

Merck & Company
Ms. Stephanie Chapman
Merck & Company
Bldg 53 Northside
Linden Ave. Gate
Linden, NJ 07036
(732) 594-1686

Four-year PC25 PM Services Maintenance Agreement.

In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability.

b) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys 5C and one 5kWe GenSys 5P PEM power plant at NAS Patuxant River, MD. .

Plug Power
Mr. Scott Wilshire.
968 Albany Shaker Rd.
Latham, NY 12110
(518) 782-7700 ex 1338

- c) Contract: A Partners LLC Commercial Fuel Cell Project Design, Installation and 5-year service and maintenance agreement on 600kW UTC PC25 power block.
Contract # A Partners LLC, 12/31/01

Mr. Ron Allison
A Partner LLC
1171 Fulton Mall
Fresno, CA 93721
(559) 233-3262

6.0 Host Facility Information



Camp Mabry, named after Brigadier General Woodford H. Mabry, the Adjutant General of Texas from January 23, 1891 to May 4, 1898, is the headquarters of the State Military Forces. The original 90 acres, located on an elevated plain, overlooking the Colorado River about three miles northwest of the Capitol Building in Austin, was selected by a group of

prominent citizens, businessmen, and Guardsmen. Governor J.S. Hogg accepted it on behalf of the state in 1892.

Currently, the post houses the Texas Military Forces Academy, which is the second state building constructed, opening on June 15, 1884. The educational facility conducts the Officer Candidate School, the (NCO) Noncommissioned Officer Academy, Medical Specialist Course and numerous other specialized schools. Also located on the post is the United States Property and Fiscal Office, one of two state Combined Support Maintenance Shops, the Texas National Guard Armory Board, the armory of the Headquarters of the 49th Armored Division, a troop medical clinic, a parachute packing and storehouse facility, plus numerous supply and warehouse facilities.

7.0 Fuel Cell Site Information



On September 20 2004, LOGAN representatives met with Dennis Feary of Camp Mabry and Frank Richards of Austin Energy to perform a site evaluation for the fuel cell project. After visiting several possible buildings the team decided to conduct the project at the Texas National Guard Museum pictured at left. The facility houses a display of numerous vehicles, various period uniforms and small arms that

have been a part of the history of the Texas Nation Guard.

The fuel cell will be installed on a pad at the rear of the building, pictured at right, in a grid parallel configuration.

The building's electrical service and natural gas service are conveniently located a short distance from the proposed pad site.

Because of the of the air dehumidification requirements of the facility to help preserve the





artifacts on display, LOGAN proposes to install a DryKor liquid desiccant system to help lower the humidity of the interior spaces of the facility, seasonally, with either warm or cool dry air. This will provide the opportunity to test a commercial cooling and heating desiccant system using waste heat from the fuel cell to maximize the thermal application of this project in contrast to others where thermal recovery was limited to existing domestic hot water utilization. The picture at left shows an existing small desiccant unit located in one of the display rooms that mitigate the adverse effects of high Texas humidity on museum artifacts.

9.0 Electrical System

The Plug Power GenSys 5C PEM fuel cell power plant provides both grid parallel and grid independent operating configurations for site power management. This capability is an important milestone in the development of the GenSys5 as it approaches product commercialization. The unit has a power output of 110/120 VAC at 60 Hz, and when necessary the voltage can be adjusted to 208vac or 220vac depending upon actual site conditions. At this site the unit will be connected to the facility in a grid parallel configuration dispatching power at 2.5 kW for most of the period of performance. However, subject to the availability of additional funding the unit



may operate at 5kW for three months to evaluate the thermal efficiency and output of the DryKor desiccant unit by providing more Btus from the fuel cell to the desiccant unit that would be available at the higher power setting. The photo at left shows the electrical service panel where the fuel cell will be electrically coupled to the base utility grid at a 50 amp circuit breaker. The electrical closet is conveniently located behind the exterior wall adjacent to the fuel cell pad site.

10.0 Thermal Recovery System

LOGAN proposes to install, integrate with the fuel cell and test a DryKor liquid desiccant unit, pictured at right, to capture the fuel cell thermal output at this site. The desiccant unit has a thermal requirement that matches very well with the Plug Power GenSys5C heat and Btu output at its normal operating range of 2.5 to 5 kW. While operating at a set point of 2.5 kWh, the fuel cell has a heat rate of approximately 33,000 Btuh and would provide 7800 Btuh to the coils in the DryKor; and twice that amount while operating at 5kW. LOGAN will install a thermal loop between the fuel cell heat exchanger and the RCC60 to transfer 135 degree hot water to its regenerative heat coils in order to recycle the liquid desiccant used in the unit.



DryKor RCC60

The DryKor RCC60 has the following additional characteristics:

Applications

- Ideal for hot humid areas and property protection
- Private Homes, Apartments and Condominiums, Seaside properties
- Private collections, Private libraries and archives, Home offices
- Allergies / Respiratory problems
- Nurseries, Small day-care facilities
- Institutions, Geriatric Homes, Clinics
- Convert attics / basements to living space

Features

- Stand-alone, self-controlled unit that Dries & Cools or Dries & Heats
- Optimal temperature control with unparalleled comfort; Independent temperature and humidity control for perfect indoor conditioned environment
- Cabinet mounted controls or Wired remote control (optional)
- Energy saving
- Do it yourself installation
- Easy and simple maintenance
- Portable - 4 wheels (optional)
- Based on the Patented, State-Of-The-Art Dry Conditioning DryKor Technology
- Full 1 year warranty

Benefits

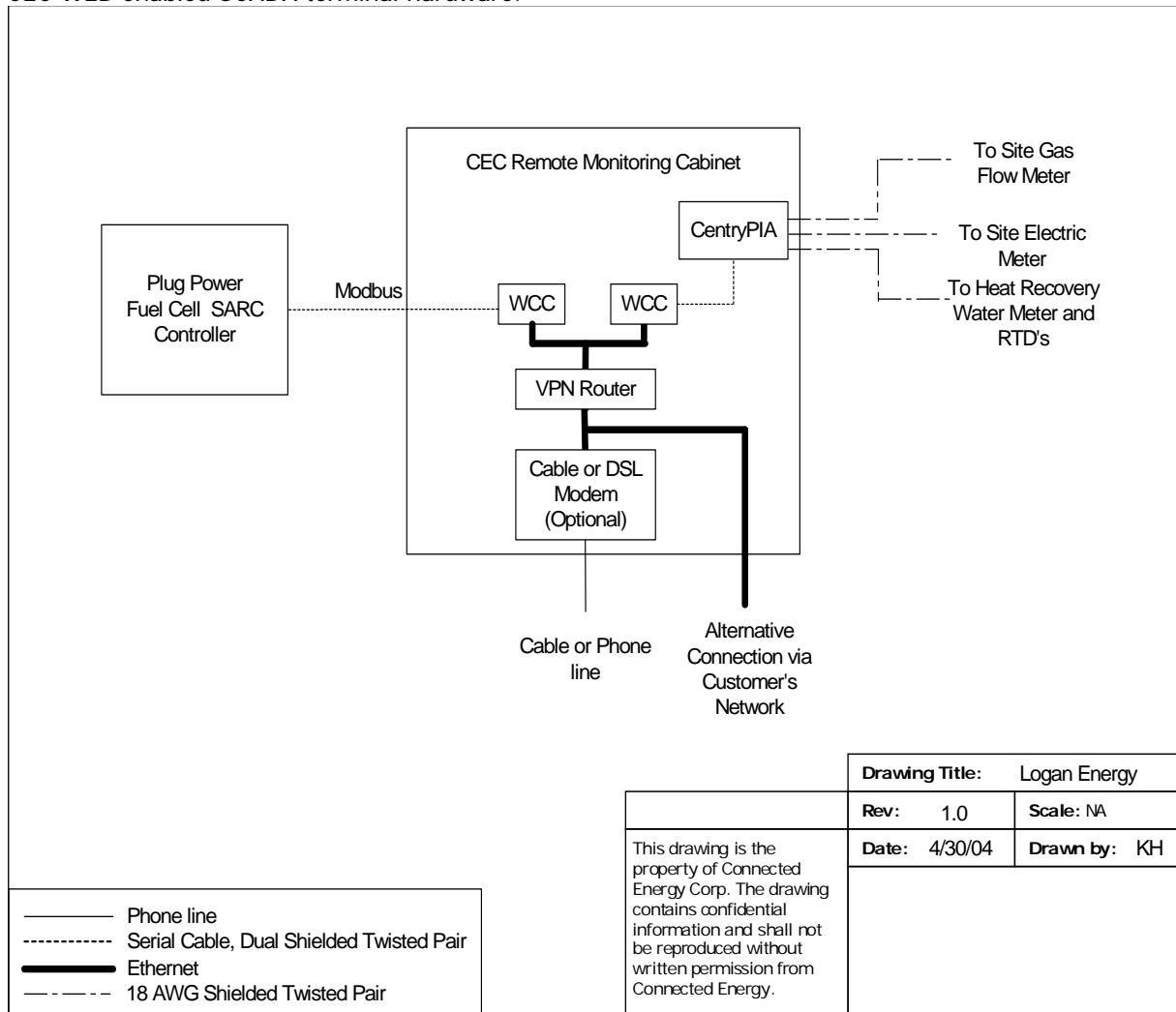
- Whole-home dehumidification
- Mold and mildew prevention
- Improves IAQ (Indoor Air Quality); air purification and removal up to 94% of microorganism, molds and airborne bacteria as well as 77% of particles larger than 5 micron
- Germicidal protection
- Up to 60% Energy Savings
- No over-cooling of air in treated space; create comfort condition with optimal humidity level without reducing to chilling temperatures
- Preserves furniture, books and art
- Reduces household odors
- Environmentally friendly; saves electricity, reduces use of refrigerant gas
- Reduces Sick Building Syndrome
- Solves problem of condensate water removal. No need for pipes, pumps drainage system or collection containers

11.0 Data Acquisition System

LOGAN proposes to install a Connected Energy Corporation web based SCADA system that provides high-speed access to real time monitoring of the power plant. The schematic drawing

seen below describes the architecture of the CEC hardware that will support the project. The system provides a comprehensive data acquisition solution and also incorporates remote control, alarming, notification, and reporting functions. The system will pick up and display a number of fuel cell operating parameters on functional display screens including kWh, cell stack voltage, and water management, as well as external instrumentation inputs including Btus, fuel flow, and thermal loop temperatures. CEC's Operations Control Center in Rochester, New York maintains connectivity by means of a Virtual Private Network that will link the fuel cell to the center.

CEC WEB enabled SCADA terminal hardware.



LOGAN will procure high-speed Internet access to the fuel cell router from a local DSL or cable service provider. The base will provide local dial tone to a phone jack that will be conveniently located in the museum's electrical closet to provide communications with the fuel cell data modem.

12.0 Economic Analysis

Camp Mabry ANGB

Project Utility Rates

1) Water (per 1,000 gallons)	\$	1.25
2) Utility (per KWH)	\$	0.0625
3) Natural Gas (per MCF)	\$	5.85

First Cost		Budgeted	Actual
Plug Power 5 kW SU-1		\$ 65,000.00	
Shipping		\$ 2,400.00	
Installation electrical		\$ 5,375.00	
Installation mechanical & thermal		\$ 7,000.00	
Watt Meter, Instrumentation, Web Package		\$ 11,090.00	
Site Prep, labor materials		\$ 825.00	
Technical Supervision/Start-up		\$ 2,500.00	
Total		\$ 94,190.00	
Assume Five Year Simple Payback		\$ 18,838.00	\$ -
Forecast Operating Expenses	Volume	\$/Hr	\$/ Yr
Natural Gas Mcf/ hr @ 2.5kW	0.0330	\$ 0.19	\$ 1,522.01
Water Gallons per Year	14,016		\$ 17.52
Total Annual Operating Cost			\$ 1,539.53
Economic Summary			
Forecast Annual kWH		19710	
Annual Cost of Operating Power Plant	\$	0.078 kWH	
Credit Annual Thermal Recovery Rate	\$	(0.014) kWH	
Project Net Operating Cost	\$	0.0638 kWH	
Displaced Utility cost	\$	0.0625 kWH	
Energy Savings (Cost)		(\$0.001) kWH	
Annual Energy Savings (Cost)		(\$26.20)	

13.0 Kickoff Meeting Information

The Camp Mabry project kick-off will occur on December 8, 2004. At that time Dr. Mike Binder representing CERL and Sam Logan representing LOGANEnergy, joined by representatives of Austin Energy will present the scope of the PEM demonstration project and the installation plan to Dennis Feary and the Camp Mabry Civil Engineering staff. Any issues that cannot be resolved at the kickoff meeting will put the commencement of the installation on hold until the base POC submits a statement in writing to Dr Binder that the project is ready to begin.

14.0 Status/Timeline

Please see Appendix Section 3 below.

Appendix

Section 1

Sample form used to qualify the fuel cell for initial start and the project acceptance test.

Installation/Acceptance Test Report

Site: Camp Mabry ANGB, Austin, TX

Installation Check List

TASK	Initials	DATE	TIME (hrs)
Batteries Installed	GC		
Stack Installed	GC		
Stack Coolant Installed	GC		
Air Purged from Stack Coolant	GC		
Radiator Coolant Installed	GC		
Air Purged from Radiator Coolant	GC		
J3 Cable Installed	GC		
J3 Cable Wiring Tested	GC		
Inverter Power Cable Installed	GC		
Inverter Power Polarity Correct	GC		
RS 232 /Modem Cable Installed	GC		
DI Solenoid Cable Installed with Diode	GC		
Natural Gas Pipe Installed	GC		
DI Water / Heat Trace Installed	GC		
Drain Tubing Installed	GC		

Commissioning Check List and Acceptance Test

TASK	Initials	DATE	TIME (hrs)
Controls Powered Up and Communication OK	GC		
SARC Name Correct	GC		
Start-Up Initiated	GC		
Coolant Leak Checked	GC		
Flammable Gas Leak Checked	GC		
Data Logging to Central Computer	GC		
System Run for 8 Hours with No Failures	GC		

Appendix Section 2

Plug Power GenSys5C Specifications

- Dimensions 84 1/2" x 32" x 68 1/4"
- Performance Continuous Power Rating 5kWe (9kWth)
Power Output 2.5-5kWe (3-9kWth)
Voltage 120/240 VAC @ 60Hz
Power Quality IEEE 519, Grid Interconnect IEEE P1547
Emissions NOX <1ppm...SOX <1ppm
- Noise <60 dBA @ 1 meter
- Operating Conditions Temperature 0°F to 104°F
- Elevation 0 to 6000 feet
- Installation Outdoor
- Electrical Connection, Grid Parallel/Grid Independent
- Fuel, Natural Gas
- Certifications Power Generation, CSA International
- Power Conditioning UL 1741— Electromagnetic Compliance FCC Class B —



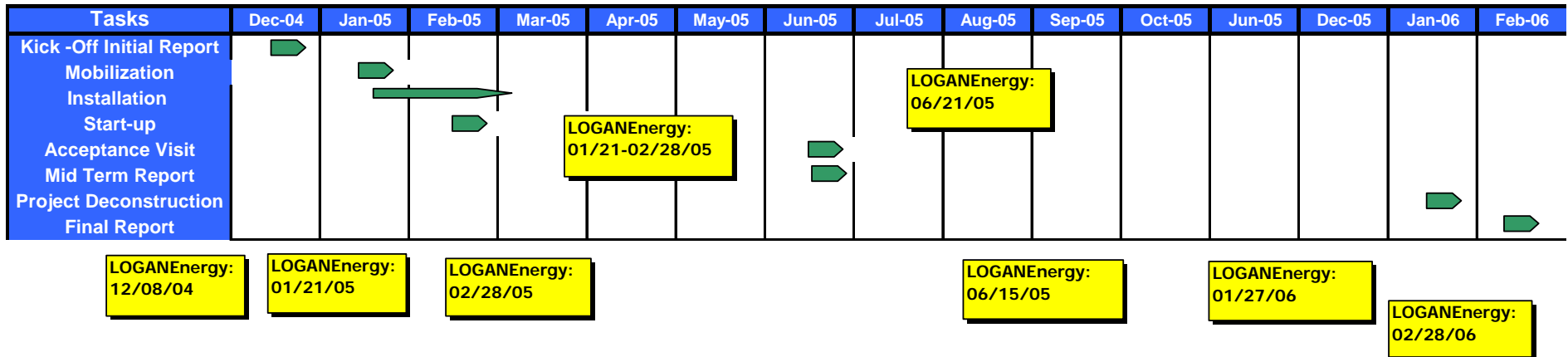
Appendix Section 3

Camp Mabry ANGB PEM Fuel Cell Demonstration Project

Installation, Monitoring, Performance Evaluations, & Reproting on One Plug Power PEM Fuel Cell At Camp Mabry ANGB

Column Headings Indicate the Beginning of Each Month

Installation Schedule



Section 4



DOD FUEL CELL PROJECT KICKOFF MEETING AGENDA

Date:

Location:

ATTENDEES	ORG.	PHONE	CELL	EMAIL

Status

1. Introduction – All (*5 mins*)
2. Background & Expectations of PEM demonstration Program – Mike Binder (*5 mins*)
3. Introduction to Project Team – Chris Davis & Mike Harvell (*10 mins*)
4. Fuel Cells System Project Description – Sam Logan – (*20-30 mins*)
 - Technology Overview OK OPEN
 - Project Installation Plan OK OPEN
 - Project Management Plan OK OPEN
 - Data Reporting and Communications OK OPEN
 - Environmental, base access and other security issues OK OPEN
5. Unresolved issues...POC approval – (*5-10 mins*) OK OPEN
6. Site Tour – All (*20 mins*)